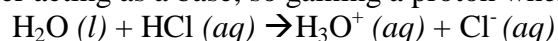


## **ANSWERS to Crystal ball questions on Conjugate acid/base pairs**

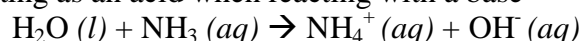
1) Conjugate acid/base pairs are two species that differ in their structure by a single proton ( $\text{H}^+$ ). In this reaction illustrating the self ionisation of water, one water molecule donates a proton ( $\text{H}^+$ ) to the other. The proton donor molecule is the acid (one of the  $\text{H}_2\text{O}$  molecules) and its conjugate base is  $\text{OH}^-$ . Another conjugate acid/base pair is  $\text{H}_2\text{O}$  as the base and  $\text{H}_3\text{O}^+$  as its conjugate acid.

2) Amphiprotic means a substance can either donate or accept protons ( $\text{H}^+$  ions). Common examples of amphiprotic substances are a water molecule ( $\text{H}_2\text{O}$ ) and the hydrogen sulfate ion ( $\text{HSO}_4^-$ )

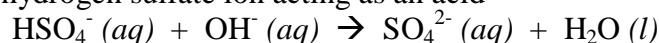
eg water acting as a base, so gaining a proton when reacting with HCl



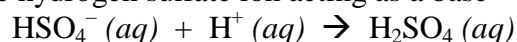
and acting as an acid when reacting with a base



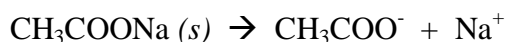
eg the hydrogen sulfate ion acting as an acid



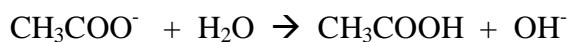
and the hydrogen sulfate ion acting as a base



3) When sodium ethanoate dissolves in water it ionises



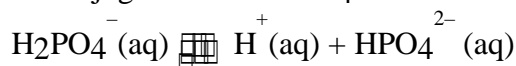
Water reacts with the ethanoate ion to form ethanoic acid



In the equation above, the  $\text{H}_2\text{O}$  acts as an acid donating a proton to the ethanoate ion, so the conjugate base of water is  $\text{OH}^-$ .

So the solution of sodium ethanoate is basic as the  $\text{OH}^-$  ions cause the pH to be above 7.

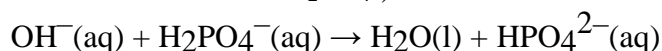
4) i) The acidic ion is  $\text{H}_2\text{PO}_4^-$  and its conjugate base is  $\text{HPO}_4^{2-}$



ii) When a small amount of a strong base ( $\text{OH}^-$ ) is added to this buffer solutions the  $\text{OH}^-$  is replaced by a weak base, so the effect of the strong base is minimised.

When a small amount of a strong base is added to a buffer, the  $\text{OH}^-$  reacts with the acidic part of the buffer to give more of the basic part of the buffer.

The strong base reacts with the acid of the buffer ( $\text{H}_2\text{PO}_4^-$ )



When a small amount of a strong acid such as HCl is added to a buffer, the  $\text{H}^+$  from the acid reacts with the basic part of the buffer to give more of the acidic part of the buffer.

